Materials for production and storage of energy

Academic Year: (2023 / 2024) **Review date: 28/04/2023 11:07:40**

Department assigned to the subject: Materials Science and Engineering and Chemical Engineering Department

Coordinating teacher: LEVENFELD LAREDO, BELEN

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Materials Science and Engineering

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

OBJECTIVES

The objective of this course is that the student knows the different systems of storage and production of energy in order to acquire capacities that allow him to understand the operation of some of the modern systems of storage and production of electrical energy and the importance that they have. the materials inside the device. Likewise, its repercussion in terms of environmental impact will be analyzed. To achieve this goal the student must acquire a series of knowledge, skills and attitudes.

With regard to knowledge, at the end of the course the student will be able to:
-Know the most current trends in the world of materials for energy in terms of their formulation and

identify the potential advantages they can offer compared to more traditional materials.
-Design ways of optimization in the properties of different materials for specific applications through modifications in their structure and composition.
-To know advanced processing and synthesis systems that allow to obtain materials for energy with improved properties.
-To acquire knowledge and useful scientific-technical skills to solve specific problems associated with work in a laboratory in the field of materials for energy.

As for the specific abilities, at the end of the course the student will be able to:
- Know the requirements that materials for energy have to meet in specific applications.
- Within certain applications, know how to identify which materials are the most used today and know the alternatives that are contemplated at this time to achieve improved properties.
- Identify the necessary requirements for the selection of materials in some energy storage and production devices.
- Be able to evaluate the reasons why materials are used in particular applications.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction
Fundamentals of electrochemistry
Fuel Cells I
Fuel cells II
Capacitors and Supercapacitors and Piezoelectrics
Superconductors
Magnetic Materials
Battery Basics
Batteries I
Batteries II
Phase change materials
Battery Characterization Techniques (laboratory)
Fuel Cell Characterization Techniques (laboratory)

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES
Theoretical-practical classes
Laboratory practices
Tutorials
Team work
Individual work of the student

METHODOLOGY
Exhibitions in the teacher's class with support of computer and audiovisual means, in which the main concepts of the subject are developed and examples of resolution of exercises or practical cases are given
Critical reading by the student of scientific texts and publications recommended by the teacher
Obtaining experimental results in the laboratory. handling equipment and research techniques, under the guidance of the teacher
Preparation of works and reports individually or in groups

ASSESSMENT SYSTEM

% end-of-term-examination/test:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

Lab practices: 10%
Team work: 20%
Exams: 70%

BASIC BIBLIOGRAPHY

- S.C. Singhal, K. Kendall High-temperature Solid Oxide Fuel Cells: Fundamentals, Design and Applications. , Elsevier. , 2003

- Vladimir S. Bagotsky, Alexander M. Skundin, Yurij M. Volfkovich Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors. , John Wiley & Sons., 2015

- Yoshinobu Tanaka. Ion Exchange Membranes: Fundamentals and Applications., Elsevier. , 2015

ADDITIONAL BIBLIOGRAPHY

- Aiping Yu, Victor Chabot, Jiujun Zhang. . Electrochemical Supercapacitors for Energy Storage and Delivery: Fundamentals and Applications., CRC Press, 2013

- Ajay Kumar Saxena. . High-Temperature Superconductors., Springer Science & Business Media,, 2012

- David P. Wilkinson, Jiujun Zhang, Rob Hui, Jeffrey Fergus, Xianguo Li. Proton Exchange Membrane Fuel Cells: Materials Properties and Performance., CRC Press., 2009

- J. M. D. Coey. Magnetism and Magnetic Materials, Cambridge University Press,, 2010

- Kuan Yew Cheong Giuliana Impellizzeri Mariana Amorim Fraga Emerging Materials for Energy Conversion and Storage, Elsevier , 2018

- Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa. Lithium-Ion Batteries: Science and Technologies. , Springer Science & Business Media, 2010